What is claimed is:

1.   A device interface apparatus having a physical
layer, a link layer, a transport layer and an
5   application layer, for transferring commands and
data in packet format by serial transmission
between a device and a host, the interface apparatus
comprising:
      a receive FIFO disposed at the transport layer
10   and storing on a first-in first-out basis a command
packet or a data packet received from the host via
the physical layer and the link layer;
      a command detection circuit detecting the
command stored in the receive FIFO during data
15   transfer and outputting a command detection signal;
      a receive task file register disposed at the
application layer and loading the command content
of the receive FIFO;
      a send task file register disposed at the
20   application layer and loading a command or data for
packet sending;
      a send FIFO disposed at the transport layer and
storing on a first-in first-out basis the content
of the send task file register, the send FIFO
25   causing a command packet or a data packet to be sent
to the host via the link lay r and the physical
layer;

an available tim gen ration unit generating
an available time for receiving another command
packet from the host during data transfer; and

a mid-transfer command processing unit, when
5   a command packet is received from the host during
the available time, suspending the data transfer
to decode the received command for execution of
processing and thereafter resuming the data
transfer.
10

2.   The interface apparatus according to claim 1,
wherein

the mid-transfer command processing unit is
firmware implemented by execution of a program, and
15   wherein

the mid-transfer command processing unit
comprises:

a suspend processing unit, when the command
detection signal is output from the command
20   detection circuit for the command packet received
during the available time and stored in the receive
FIFO, suspending the currently executed data
transfer and saving parameters upon the suspension
into a memory;
25   a command decode unit decoding the command
content loaded from the r ceive FIFO into th
receive task file register;

a data transfer abort unit, when abortion of the data transfer is determined by the command decode unit, discarding the currently executed command and the saved parameters and terminating

5   the data transfer; and

a transfer resume unit, when continuance of the data transfer is determined by the command decode unit, throwing the command content of the receive task file register into a command queue, storing

10   command reception response information into the send FIFO and sending a command reception response packet to the host via the link layer and the physical layer, the transfer resume unit thereafter releasing the suspend of the data transfer and

15   setting the saved parameters to resume the data transfer.

3.   The interface apparatus according to claim 1, wherein

20   the available time generation unit detects completion of the transfer of the data packet sent to or received from the host to thereby set certain available time.

25   4.   The interface apparatus according to claim 2, wherein

the transfer resume unit rewrit s the data

stored in the s nd FIFO upon suspending of data
transfer into response data to the received command
for transfer of a command reception response packet,
the transfer resume unit thereafter setting the

5   saved parameters to resume the data transfer.

5.   A device interface apparatus for transferring
commands and data in packet format by serial
transmission between a device and a host, the

10   interface apparatus comprising:
        a receive FIFO storing on a first-in first-out
basis a command packet or a data packet received
from the host;
        a command detection circuit detecting the

15   command stored in the receive FIFO during data
transfer and outputting a command detection signal;
        a receive task file register loading the
command content of the receive FIFO;
        a send task file register loading a command or

20   data for packet sending;
        a send FIFO storing on a first-in first-out
basis the content of the send task file register
and causing a command packet or a data packet to
be sent to the host;

25   an available time generation unit generating
an available time for r ceiving another command
packet from th host during data transf r; and

a mid-transf r command processing unit, when
a command packet is received from the host during
the available time, suspending the data transfer
to decode the received command for execution of

5   processing and thereafter resuming the data
transfer.

6.   The interface apparatus according to claim 1,
wherein

10   the mid-transfer command processing unit is
firmware implemented by execution of a program, and
wherein

the mid-transfer command processing unit
comprises:

15   a suspend processing unit, when the command
detection signal is output from the command
detection circuit for the command packet received
during the available time and stored in the receive
FIFO, suspending the currently executed data

20   transfer and saving parameters upon the suspension
into a memory;

a command decode unit decoding the command
content loaded from the receive FIFO into the
receive task file register;

25   a data transfer abort unit, when abortion of
the data transfer is determined by the command
decode unit, discarding the curr ntly executed

command and the saved parameters and terminating the data transfer; and

a transfer resume unit, when continuance of the data transfer is determined by the command decode

5   unit, throwing the command content of the receive task file register into a command queue, storing command reception response information into the send FIFO and sending a command reception response packet to the host, the transfer resume unit

10   thereafter releasing the suspend of the data transfer and setting the saved parameters to resume the data transfer.

7.   The interface apparatus according to claim 5,

15   wherein

the available time generation unit detects completion of the transfer of the data packet sent to or received from the host to thereby set certain available time.

20

8.   The interface apparatus according to claim 6, wherein

the transfer resume unit rewrites the data stored in the send FIFO upon suspending of data

25   transfer into response data to the received command for transfer of a command reception response packet, the transfer resume unit thereafter setting the

saved parameters to resume the data transfer.

9.   A packet transfer method for a device interface having a physical layer, a link layer, a transport layer and an application layer, the device interface transferring commands and data in packet format by serial transmission between a device and a host, the device interface including:

a receive FIFO disposed at the transport layer and storing on a first-in first-out basis a command packet or a data packet received from the host via the physical layer and the link layer;

a command detection circuit detecting the command stored in the receive FIFO during data transfer and outputting a command detection signal;

a receive task file register disposed at the application layer and loading the command content of the receive FIFO;

a send task file register disposed at the application layer and loading a command or data for packet sending; and

a send FIFO disposed at the transport layer and storing on a first-in first-out basis the content of the send task file register, the send FIFO causing a command packet or a data packet to be sent to the host via the link layer and the physical lay r;

the packet transfer method comprising:

an available time generation step generating an available time for receiving another command packet from the host during data transfer; and

5   a mid-transfer command processing step, when a command packet is received from the host during the available time, suspending the data transfer to decode the received command for execution of processing and thereafter resuming the data

10   transfer.

10. The packet transfer method according to claim 9, wherein

the mid-transfer command processing step

15   comprises:

a suspend processing step, when the command detection signal is output from the command detection circuit for the command packet received during the available time and stored in the receive

20   FIFO, suspending the currently executed data transfer and saving parameters upon the suspension into a memory;

a command decode step decoding the command content loaded from the receive FIFO into the

25   receive task file register;

a data transfer abort step, when abortion of the data transfer is d termin d by the command

decode step, discarding th currently execut d command and the saved parameters and terminating the data transfer; and

a transfer resume step, when continuance of the
5   data transfer is determined by the command decode step, throwing the command content of the receive task file register into a command queue, storing command reception response information into the send FIFO, sending a command reception response
10   packet to the host via the link layer and the physical layer, thereafter releasing the suspend of the data transfer and setting the saved parameters to resume the data transfer.

15   11. The packet transfer method according to claim 9, wherein

the available time generation step includes detecting completion of the transfer of the data packet sent to or received from the host and setting
20   certain available time.

12. The packet transfer method according to claim 10, wherein

the transfer resume step includes rewriting
25   the data stored in the send FIFO upon suspending of data transfer into r sponse data to the r ceived command for transfer of a command reception

response packet and ther after setting the saved
parameters to resume the data transfer.

13. A packet transfer method for a device interface

5   transferring commands and data in packet format by
serial transmission between a device and a host,
the device interface including:
a receive FIFO storing on a first-in first-out
basis a command packet or a data packet received

10   from the host;
a command detection circuit detecting the
command stored in the receive FIFO during data
transfer and outputting a command detection signal;
a receive task file register loading the

15   command content of the receive FIFO;
a send task file register loading a command or
data for packet sending; and
a send FIFO storing on a first-in first-out
basis the content of the send task file register

20   and causing a command packet or a data packet to
be sent to the host;
the packet transfer method comprising:
an available time generation step generating
an available time for receiving another command

25   packet from the host during data transfer; and
a mid-transfer command processing step, when
a command packet is r ceived from the host during

the available time, susp nding the data transfer
to decode the received command for execution of
processing and thereafter resuming the data
transfer.

5

14. The packet transfer method according to claim
13, wherein

the mid-transfer command processing step
comprises:

10   a suspend processing step, when the command
detection signal is output from the command
detection circuit for the command packet received
during the available time and stored in the receive
FIFO, suspending the currently executed data
15 transfer and saving parameters upon the suspension
into a memory;

a command decode step decoding the command
content loaded from the receive FIFO into the
receive task file register;

20   a data transfer abort step, when abortion of
the data transfer is determined by the command
decode step, discarding the currently executed
command and the saved parameters and terminating
the data transfer; and

25   a transfer resume step, when continuance of the
data transfer is determined by the command decode
step, throwing the command content of the receive

task file register into a command queue, storing command reception response information into the send FIFO, sending a command reception response packet to the host, thereafter releasing the suspend of the data transfer and setting the saved parameters to resume the data transfer.

15. The packet transfer method according to claim 13, wherein

the available time generation step includes detecting completion of the transfer of the data packet sent to or received from the host and setting certain available time.

16. The packet transfer method according to claim 14, wherein

the transfer resume step includes rewriting the data stored in the send FIFO upon suspending of data transfer into response data to the received command for transfer of a command reception response packet, and thereafter setting the saved parameters to resume the data transfer.

17. A device interface apparatus having a physical layer, a link layer, a transport layer and an application layer, for transferring commands and data in pack t format by serial transmission

b tween a device and a host, the interfac apparatus comprising:

a receive FIFO disposed at the transport layer and storing on a first-in first-out basis a command

5   packet or a data packet received from the host via the physical layer and the link layer;

a receive task file register disposed at the application layer and loading the command content of the receive FIFO;

10   a send task file register disposed at the application layer and loading a command or data for packet sending;

a send FIFO disposed at the transport layer and storing on a first-in first-out basis the content

15   of the send task file register, the send FIFO causing a command packet or a data packet to be sent to the host via the link layer and the physical layer;

an I/O control unit inputting and outputting

20   data such that predefined one unit of data stays in the send FIFO at all times, the I/O control unit outputting a head signal in synchronism with input and output of headmost data of the packet and outputting a tail signal in synchronism with input

25   and output of endmost data of the packet; and

an error-terminated transfer control unit, when data input is halted by an error during data

transmission, outputting to the link layer th one
unit of data staying in the send FIFO together with
the tail signal and causing a data packet to be
transferred to the host.

5

18. The interface apparatus according to claim 17,
wherein
        the I/O control unit when received data is
stored into the send FIFO, stores the received data
10 after outputting the previously received data.

19. The interface apparatus according to claim 17,
wherein
        the I/O control unit forces the minimum unit
15 of data to stay as one unit of data in the send FIFO.

20. A packet transfer method for a device interface
having a physical layer, a link layer, a transport
layer and an application layer, the device
20 interface transferring commands and data in packet
format by serial transmission between a device and
a host, the device interface including:
        a receive FIFO disposed at the transport layer
and storing on a first-in first-out basis a command
25 packet or a data packet received from the host via
the physical layer and the link layer;
        a receive task file register dispos d at the

application layer and loading the command content
of the receive FIFO;

a send task file register disposed at the
application layer and loading a command or data for
5   packet sending; and

a send FIFO disposed at the transport layer and
storing on a first-in first-out basis the content
of the send task file register, the send FIFO
causing a command packet or a data packet to be sent
10   to the host via the link layer and the physical
layer;

the packet transfer method comprising:

an I/O control step inputting and outputting
data such that predefined one unit of data stays
15   in the send FIFO at all times, the I/O control step
outputting a head signal in synchronism with input
and output of headmost data of the packet and
outputting a tail signal in synchronism with input
and output of endmost data of the packet; and

20   an error-terminated transfer control step,
when data input is halted by an error during data
transmission, outputting to the link layer the one
unit of data staying in the send FIFO together with
the tail signal and causing a data packet to be
25   transferred to the host.

21.   The packet transfer method according to claim

20, wherein

the I/O control step includes, when received data is stored into the send FIFO, storing the received data after outputting the previously

5   received data.

22. The packet transfer method according to claim 20, wherein

the I/O control step includes forcing the

10   minimum unit of data to stay as one unit of data in the send FIFO.

23. A device interface apparatus having a physical layer, a link layer, a transport layer and an

15   application layer, for transferring commands and data in packet format by serial transmission between a device and a host, the interface apparatus comprising:

a packet control condition setting unit when

20   the command received from the host is decoded to start the packet transfer, setting a type of a control function executed after start of the packet transfer and the number of packets to be received or transmitted which defines the start or end of

25   the control function; and

a packet control xecution circuit unit detecting that the set number of packets has been

reached during packet transfer and terminating or activating the control function.

24. The interface apparatus according to claim 23,
5 wherein

the packet control condition setting unit, prior to start of the packet transfer, sets the number of packets for canceling inhibition of a reception ready response to a command transmission
10 request from the host during packet transfer, and wherein

the packet control execution circuit unit activates an inhibition operation of the reception ready response to the command transmission request
15 from the host at the time of start of the packet transfer, the packet control execution circuit unit canceling the inhibition operation when the number of the transferred packets reaches the set number of packets.
20

25. The interface apparatus according to claim 23, wherein

the packet control condition setting unit, prior to start of the packet transfer, sets a power
25 mode after packet transfer and the number of packets for entering the pow r mode, and wherein

the packet control execution circuit unit

instructs to enter the power mode when th number
of the transferred packets reaches the set number
of packets after start of the packet transfer.

5   26. A packet transfer method for a device interface
having a physical layer, a link layer, a transport
layer and an application layer, the device
interface transferring commands and data in packet
format by serial transmission between a device and
10   a host, the packet transfer method comprising:
        a packet control condition setting step when
the command received from the host is decoded to
start the packet transfer, setting into a control
register a type of a control function executed after
15   start of the packet transfer and the number of
packets to be received or transmitted which defines
the start or end of the control function; and
        a packet control execution step detecting that
the set number of packets of the control register
20   has been reached during packet transfer and
terminating or activating the control function.

27. The packet transfer method according to claim
26, wherein
25   the packet control condition setting step
includes, prior to start of the packet transfer,
setting the number of packets for canceling

inhibition of a reception ready response to a command transmission request from the host during packet transfer, and wherein

the packet control execution step includes

5 activating an inhibition operation of the reception ready response to the command transmission request from the host at the time of start of the packet transfer, and canceling the inhibition operation when the number of the transferred packets reaches

10 the set number of packets.

28. The interface apparatus according to claim 26, wherein

the packet control condition setting step

15 includes, prior to start of the packet transfer, setting a power mode after packet transfer and the number of packets for entering the power mode, and wherein

the packet control execution circuit step

20 includes instructing to enter the power mode when the number of the transferred packets reaches the set number of packets after start of the packet transfer.

25 29. A device interface apparatus having a physical layer, a link lay r, a transport layer and an application layer, for transf rring commands and

data in pack t format by serial transmission between a device and a host, the interface apparatus comprising:

a packet control condition setting unit when 5 the command received from the host is decoded to start the packet transfer, setting a type of a control function executed after start of the packet transfer; and

a packet control condition monitor unit, 10 posterior to start of the packet transfer, detecting a packet transfer status which determines start or termination of the control function and activating or terminating the control function.

15 30. The interface apparatus according to claim 29, wherein

the packet control condition setting unit, prior to start of the packet transfer, sets inhibition of a reception ready response to a 20 command transmission request from the host during packet transfer, and wherein

the packet control condition monitor unit activates an inhibition operation of the reception ready response to the command transmission request 25 from the host at the time of start of the packet transfer, the packet control condition monitor unit canceling th inhibition operation when the numb r

of the transferred packets reach s a predetermined
number of packets.

31. The interface apparatus according to claim 29,
5 wherein
the packet control condition setting unit,
prior to start of the packet transfer, sets a power
mode after packet transfer, and wherein
the packet control condition monitor unit
10 instructs to enter the power mode when the number
of the transferred packets reaches a predetermined
number of packets after start of the packet
transfer.

15 32. A packet transfer method for a device interface
apparatus having a physical layer, a link layer,
a transport layer and an application layer, the
device interface transferring commands and data in
packet format by serial transmission between a
20 device and a host, the packet transfer method
comprising:
a packet control condition setting step when
the command received from the host is decoded to
start the packet transfer, setting a type of a
25 control function executed after start of the packet
transfer; and
a packet control condition monitor step,

posterior to start of the packet transfer,

detecting a packet transfer status which determines

start or termination of the control function and

activating or terminating the control function.

5

33. The packet transfer method according to claim

32, wherein

the packet control condition setting step

includes, prior to start of the packet transfer,

10 setting inhibition of a reception ready response

to a command transmission request from the host

during packet transfer, and wherein

the packet control condition monitor step

includes activating an inhibition operation of the

15 reception ready response to the command

transmission request from the host at the time of

start of the packet transfer, and canceling the

inhibition operation when the number of the

transferred packets reaches a predetermined number

20 of packets.

34. The packet transfer method according to claim

32, wherein

the packet control condition setting step,

25 prior to start of the packet transfer, setting a

power mode after packet transfer, and wherein

th packet control condition monitor step

includes instructing t enter the power mode wh n

the number of the transferred packets reaches a

predetermined number of packets after start of the

packet transfer.

5